FACULTY OF ENGINEERING AND ARCHITECTURE

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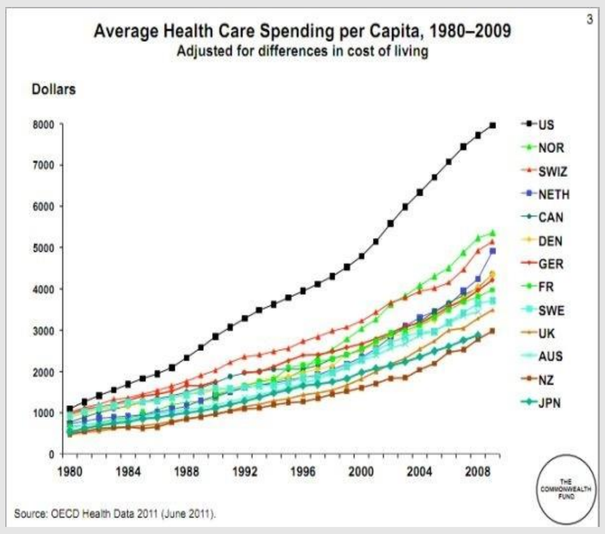
OPERATIONS RESEARCH IN HEALTHCARE: ROBUST SURGERY SCHEDULING

Providing care is a global challenge

An aging population and rising standards for healthcare, are leading to increased healthcare spending all across Europe and the developed world.

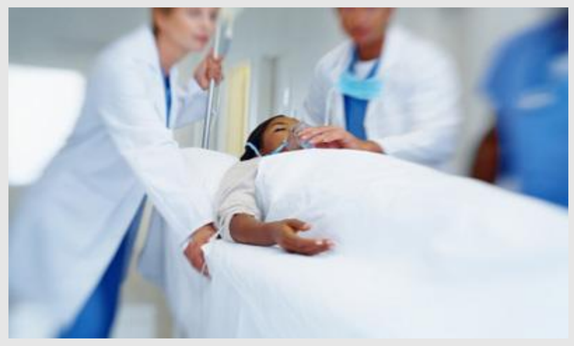


Strong need for various efficiency improvements

Operations Research in Healthcare

The operating room leads to a significant portion of total costs (as well as total revenue), and is frequently a target for improvement.

Good initial schedules are essential.



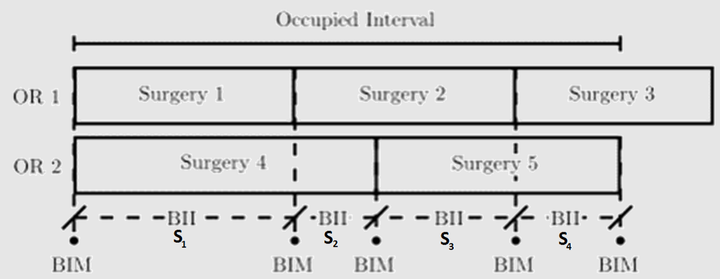
Scheduling is one of the major focuses of Operations Research!
<u>But</u> healthcare scheduling needs a special approach:

- Humans can't be treated as product
- **Stochasticity** (of durations, arrivals) has a strong impact
- Potential of **emergencies**

'Break-In-Moment' Problem

Scheduling algorithms can optimize for makespan, resources, variability… but also for many background factors.

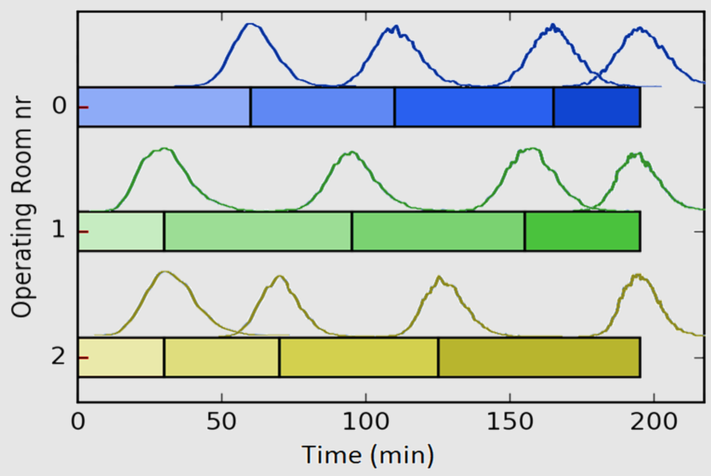
Current focus: <u>waiting time of emergency patients</u>
Based on Essen (2008): <u>the BIM Problem</u>.
A set of M surgeries are given, pre-assigned to N operating rooms.
"Find the permutation order of surgeries π that minimizes the maximal break-in-interval"



$$\pi_{optimal} = \text{argmin}_{\pi} \ \max\{S_i\}$$

However, surgeries are delicate and their duration unpredictable: they exhibit <u>high amounts of stochasticity</u>, not taken into account in the original model.

We add this to the model, creating the Stochastic BIM Problem.
Significantly more complex!

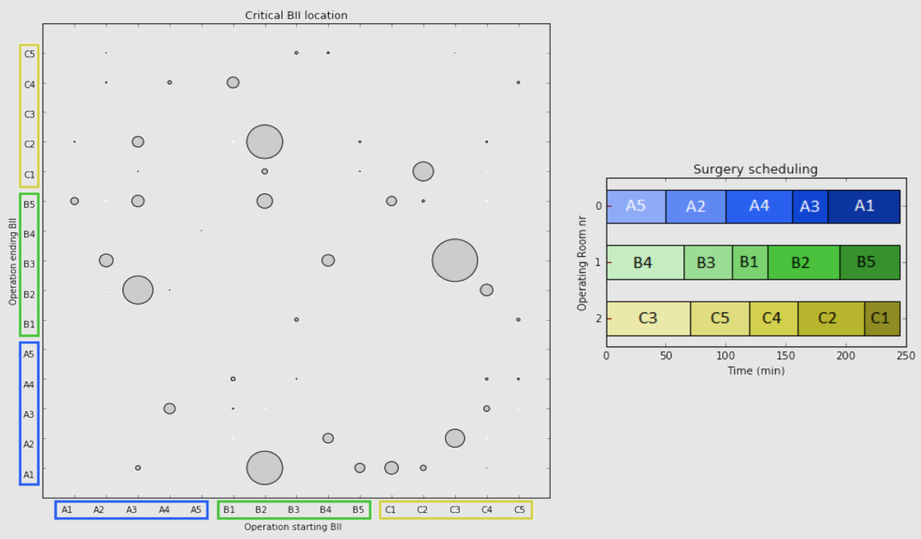


$$\pi_{optimal} = \text{argmin}_{\pi} \ E[g(\max\{S_i\})]$$

Solution methods

Solving the problem consists of:
- Integer Linear Programs to set bounds on the solution.
- Sample Average Approximation (Kleywegt 2001) captures uncertainty.
- Local search heuristics (e.g. Tabu) to further improve solutions.

Stochasticity can be analysed, and its effects minimised.



Expected results:
- Emergency risk better spread out over the day
- More robust and realistic schedules
- Higher patient satisfaction

Future work: expand objective to stochastic emergencies and new quantities

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